PTO 08-6093

CC=FR DATE=20000225 KIND=A1
PN=2782504

PROCESS FOR CONCEALED FOLDING OF LAYERED PAPER SHEETS INTENDED FOR CROSS FOLDING

(Procède de pliage furtif des feuilles de papier superposées et destinées a des pliages croisés)

Bernard Maurice Ganneval

UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. July 2008

Translated by: FLS, Inc.

PUBLICATION COUNTRY	(19):	FR
DOCUMENT NUMBER	(11):	2782504
DOCUMENT KIND	(12):	A1
PUBLICATION DATE	(43):	20000225
APPLICATION NUMBER	(21):	9810502
DATE OF FILING	(22):	19980818
ADDITION TO	(61):	
INTERNATIONAL CLASSIFICATION	(51):	B65H 45/28
PRIORITY	(30):	
INVENTORS	(72):	GANNEVAL, BERNARD MAURICE
APPLICANT	(71):	BERNARD MAURICE GANNEVAL
DESIGNATED CONTRACTING STATES	(81):	

TITLE (54): PROCESS FOR CONCEALED FOLDING OF LAYERED PAPER SHEETS INTENDED FOR CROSS FOLDING

FOREIGN TITLE (54A): PROCÈDE DE PLIAGE FURTIF DES FEUILLES DE PAPIER SUPERPOSEES ET DESTINEES A DES PLIAGES CROISÉS

Description /1*

This invention concerns a folding process for sheet materials that are layered and destined for cross folding, such as paper employed for the fabrication of printed and bound books, made possible by cutting tools.

Cross folding of layered sheet materials such as paper, brings about stress from tensions on the extrados of bends and compression on the intrados of bends, which translates into pleats at the perpendicular crossings of successive folds, and by misaligned positions of each of the pages of the signature, or cahier, produced by folding.

Cross folding of paper in superimposed sheets is traditionally accomplished by the graphics industry through various folding devices. Rotary drum presses generally have a folding machine that includes at least one longitudinal folding unit, and units for making transversal folds, perpendicular to the preceding folds. This can be implemented with belts the width of the drums, or even with ribbons that previously have been cut longitudinally. All productions of signatures, or cahiers, accomplished by these means are subject to the formation of said pleats which arise at the point of cross folding. These pleats are consequently multiple. They deteriorate the visual appearance of the printed book, sometimes hiding the letters of text,

* Numbers in the margin indicate pagination in the foreign text.

and cause undulations in it that alter the perception of the printed image. They cause misalignment of each of the pages of the intrados of the folds. They are the cause of subsequent misalignments of these pages, through expansion during the lifetime of the printed book. Physically, they generate excessive thickness of the corners compared to the remainder of the signatures, which translates into serious problems in putting them in large numbers into assembled groups of units for the final binding. This often means deformations in these /2 groups of units. But this excess thickness of signatures also causes excess thickness of the corners of the final book, which can include several of them.

The seriousness of pleats increases with the number of pages in the signatures, and with the thickness of the paper employed. This leads to serious problems in producing signatures of 32 pages and 48 pages, or more, with thick papers, for which reason it is commonly considered that signature pagination should be limited to 24 pages, or 16 pages, or even 8 pages. The consequences of cross folding pleats from perpendicular folds are thus visual, practical, and economic. Their elimination will improve the visual appearance of printed books, which will satisfy customers and readers. This will restore the geometry of signatures and that of the final books, which will also improve binding operations. Their elimination will also improve the economy of fabrication of printed books by offering the opportunity to produce signatures with large numbers of pages with thick paper

stocks, without having to lower the speed of rotary production or binding equipment.

For decades there have been attempts to eliminate these pleats and remedy the imperfections that they lead to, either by making a linear perforation on the fold line that will be crossed by a subsequent one, or by making very elaborate, jagged cuts on the same line, or by making a cut on part of this line. If some of these methods, which sometimes require the installation of sizable and onerous devices, reduce pleats and/or shift them within the printed and folded signatures, none has solved the problem posed satisfactorily. Indeed, the undulations of pages persist, and their positioning is always misaligned. The cutting devices according to this invention are intended to eliminate the cause of the formation /3 of pleats by creating a process which did not exist until now in the folding equipment of rotary drum presses, nor in the other paper folding equipment of the graphics industry.

This invention rests on two principals. The first principal is that until now the signatures printed and folded by the graphics industry have two cross folds, more often three cross folds, sometimes more. And if it is imperative to retain folds made in order to allow subsequent bookbinding operations, which are done at higher and higher speeds thanks to automation, it is not essential to keep all of them. Analysis of the precise conditions of binding is thus necessary. The second principal is that if pleats are produced, it is due to the

connection of the sheets to each other, which persists after their folding, and which becomes the place where stresses in opposite directions from tension and compression are encountered, caused by the bending of the layered stack of sheets when crossing on a preceding fold. Shearing occurs there. It is advisable, therefore, to eliminate the connections of the folded sheets in those places where the presence of the fold made is not essential for binding. Thus, folding, the first goal of which is to place the pages of the signature within a crossing sequence, repetitively and in as many copies as desired, can be concealed if it has no subsequent technical role to play.

For this reason, this invention introduces a first cutting tool at the first longitudinal fold, placed under the lower point of the triangle that makes the fold to avoid any undesired shifting of the paper in its downstream progression. In this way, this first longitudinal fold exists only transiently. It will persist there only during the time needed for the correct placement of the pages that it involves. Thus, the sheets, layered like ribbons, are not to be /4 reunited and can be subjected to cross folding perpendicular to the first fold without causing the formation of creases, because they will be free to shift laterally under the action of the stresses of tension and/or compression to which they are subjected.

This invention introduces a second tool, the role of which is to produce a delayed cut. It involves a blade which includes a linear row

of straight cutting parts, alternating with saw teeth. Applied like ordinary perforating blades, as currently exist, precisely on the line intended for the first fold, with penetration as rendered necessary by the thickness of the layered sheets, and supporting itself on the usual backing plate of an ordinary perforator, the tool makes it possible to cut layered sheets while keeping them connected by points of attachment created by the teeth. The contour and the height of the teeth, or depending on the case, the adjustment of the penetration depth of the tool, makes it possible to set the residual length of the points of attachment required by the book and the nature of the paper employed. During a first fold of layered sheets, the points of attachment created by the teeth permit retention of the material within the first fold, which keeps the sheets united together. The whole thing can thus be folded, then scrolled down by the usual means in the industry, to the cross folding position, which follows. While the second fold is being accomplished by crossing the preceding one which was previously treated by the tool according to the invention, the opposing stresses of tension and compression that are expressed within the thickness of the layered sheets, generate a shearing force where they meet. This shearing stress varies approximately according to the thickness of the collection of layered sheets multiplied by 3.1416 and the characteristics of the paper. And, each of the points /5 of attachment made by the tool according to the invention then transforms into a breaking point of dimensions regulated by adjusting

the penetration. In this way the sheets are freed of any connection with each other and can shift laterally without causing pleats. Thus, the second tool according to the invention initiates, at one point in time, a cut in the paper, which is finished during the second fold. Therefore, it also involves a concealed fold which will exist only during the time of the trajectory going from the first folding station considered, to the one that follows it.

The two tools according to the invention participate in the process that enables elimination of pleats and their consequences, such as undulations, excessive thickness of signatures and bound books, as well as operational problems at the binding stage, and limitations in the number of pages of signatures achievable with thick papers by several cross folds. And with the progress of techniques to come, the process can function as well thanks to other means of cutting, such as high pressure water, ultrasound, laser, or others. And this process, as it is, or with other means of cutting, makes it possible to mathematically program the precise placement of the computer graphics pagination of each of the pages of the signature of the book. It will give rise to the creation of new printing software, an appropriate professional term, which will integrate the thickness of paper employed to predict the final placement of pages after their lateral shifting during folding.

According to particular ways of achievement:

- The first tool according to the invention, situated under the low

point of the triangle of the rotary drum press which achieves the first longitudinal fold, can be a cutting blade, or a cutting wheel, placed on a bracket which makes it possible to adjust its height, angle of attack, and penetration depth. This bracket is hinged in /6 such a way that the cutting tool can be taken out of operation when needed. The device assembly should be sufficiently solid to resist the mechanical stresses that sometimes result from the rupture of paper. Since the cutting part of this first cutting device is fixed during its operation, it is subjected to the abrasion introduced by the mineral components of paper, and to the high thermal stresses introduced by the scrolling of paper at high linear velocities. It is thus interchangeable in order to allow it to always give a high quality cut. By way of a non-limiting example, the cutting part of this first device can be a treated steel blade, of 1 millimeter thickness with a ground edge beveled at 20°, and can be installed on a track which allows positioning it into the desired position and locking it into place by clamping. The bracket can have a metal base solidly fastened to the frame of the machine facing the lower point of the triangle and a hinged arm, also metal, that permits adjustment of its angle of attack into the paper, and its removal from operation;

- The second tool according to the invention can be configured to treat the entire width of the first fold considered, and in this case the placement of the cross of the second fold would correspond to a clean cut going completely through the fold, across a length which, by

way of a non-limiting example, can be twenty times the thickness of the sheets layered together by the first fold;

- This second tool can be configured to treat only one side of the first fold, and in this case the clean cut begins on a single side at the precise point where the second fold is predicted to cross, the other side of the tool would then begin with the complete absence of a cutting edge and teeth, which may be essential for satisfying certain subsequent stages of binding of the printed books. The length of the clean cut, by way of a non-limiting example, could be twenty times /7 the thickness of the sheets layered by the first intended fold, or on that order of magnitude;

- This second tool can be configured in such a way that its lateral positioning is adjustable in order to draw in the best part of it, by providing clearance, by way of a non-limiting example, within the mounting holes, which also allows inverting the operational side of the delayed cutter according to the invention. This can be rendered necessary by certain paper folding equipment configurations, and by certain binding techniques;

- The second tool according to the invention can be fabricated from metal or from any material allowing the fabrication of cutting tools. But the process can also evolve with progress in cutting technology.

The attached figures illustrate the invention:

Figure 1 represents the development of opposed stresses of tension (2) and compression (3) which meet within the plane (4) during

the bending and folding on the line (1) of a stack of layered sheets. Figure 2 represents schematically the succession most frequently encountered in longitudinal (5 and 6) and transversal (7) cross folds in rotary drum press paper folding equipment. Figure 2 also shows the position (8) where the first cutting tool of the process according to the invention should be placed, and the position (9) where the second, delayed cutting tool should be placed, within a cylindrical tool carrier, with its cylindrical backing plate (10). It is thus at this point that the delayed cut is made, on the line where the first fold (7) will occur, to be completed at the subsequent cross fold (6), made at the folding station (12). Figure 3 represents by way of a non-limiting example, the first cutting tool placed under the lower point (8) of the triangle (11) of the folding equipment of a rotary drum press.

Figure 4 represents by way of a non-limiting example, the /8 contour of the delayed cutting tool of the invention, in its one-sided variant. One clean cut section (13) and a non-cutting section (14) are situated completely across the exact point considered for cross folding. Figure 5 represents by way of a non-limiting example, details of the lateral perforation part (20) consisting of teeth (18) alternating with non-cutting sections (19), which is intended only for facilitating the folding of the layered sheets and allows any trapped air to escape. The teeth (18) can be pitched, contoured, ground, and of variable height, depending on needs. Figure 6 represents by way of

a non-limiting example, details of the contour of the lateral part of the delayed cutting tool of the invention (21), which consists of a succession of clean cuts (16), that begin exactly at the point foreseen for the crossing of two intended folds (13), alternated by teeth (15) the pitch, contour, depth, grinding, number and placement of which can be adapted as needed. In reference to Figure 4, the delayed cutting tool can, by way of a non-limiting example, include modifications (17) to the holes (22) intended for attaching it to the cylindrical tool carriage, to allow precise adjustment of its lateral position, as well as inversion of the operational side by turning it around. The delayed cutting tool of the invention is a blade that can, by way of a non-limiting example, have a thickness of 1.0 to 2.0 mm and the cross section of which can be rectangular, or trapezoidal, or of any other shape according to needs and the folding equipment considered. By way of a non-limiting example, the lateral non-cutting sequence (14) is at least 10 mm long when it involves folding layered sheets of paper, and the lateral cutting sequence (13) has a length equal to twenty times the thickness of the sheets of layered paper /9 after the first intended fold. By way of a non-limiting example, the cutting sequences of the delayed cutting tool of Figure 4 can have a ground edge of 20°. The height (23) of the delayed cutting tool of the invention is determined by the ratings of the construction of the folding equipment considered.

The location (8) chosen for the placement of the first cutting

tool of Figure 3 is an innovation that can justifiably replace the current technique of cutting at the center of the apical side of the triangle, sometimes employed. The second delayed cutting tool can be combined with the first when two successive folds are intended to be crossed. They can also be utilized separately, according to needs. The process of making concealed folds according to the invention, rendered possible by the two tools of the invention, can evolve and makes it possible to envision two, or three cross folds without pleats, and more, multiplying them as many times as needed and by modifying the paper folding equipment considered.

The first cutting tool and the second delayed cutting tool according to the invention work together, or separately, in a concealed folding process that is particularly well adapted to cross folding layered sheets of paper in folding equipment placed in line within rotary drum presses, and those that are achieved paper sheet folding equipment in binderies.

CLAIMS /10

1) Process for folding particularly well adapted to folding layers of paper sheets in the paper folding machines that equip rotary drum presses, and to those of binderies that fold sheets characterized by the utilization of two cutting tools, of whatever type, one of which is delayed.

2) Process for folding according to Claim 1 characterized in that it implements a first cutting tool placed underneath the lower point of the triangle (8); this first tool can be endowed with a replaceable cutting blade (23) or cutting wheel, is fixed when in operation, can be adjusted in height (24), angle of attack (25), and depth of penetration (26), and makes it possible to cut the paper in the first longitudinal fold immediately after it is made by the triangle (11).

3) Process for folding paper according to Claim 1 characterized by the fact that the second cut is terminated by the shearing effect resulting from opposing stresses of tension and compression, which develop within the thickness of layered sheets subjected to successive cross-folding.

4) Process of folding according to Claim 3 characterized in that it implements a second cutting tool with alternating sequences of teeth that delay this cut by leaving points of attachment within the layered sheets of paper, in anticipation of the shearing stress that will be produced during the course of cross-folding perpendicular to it on the line on which the delayed cut was made; this second tool

initiates the cut on the line of the first fold (7), but it is not completed until the shearing effect generated by the next cross fold (6) transforms the points of attachment into break points, which free each of the layered sheets and allows them to shift laterally. /11

5) Process of folding according to Claims 2, 3, and 4 characterized in that the two cutting tools can be utilized simultaneously or separately, as needed.

6) First cutting tool utilized in the process according to Claim 2 characterized by the hinging (25) of its bracket, which allows it to be put into operation or taken out of operation.

7) Second cutting tool utilized in the process according to Claims 3 and 4 characterized in that it can involve a blade that can be located within existing devices in rotary drum press paper folding machines, and those in binderies.

8) Second cutting tool utilized in the process according to Claims 3, 4, and 7, characterized by a linear succession of straight cutting parts (13, 16), alternated by sequences of saw teeth (15), the size and placement of which are determined depending on the characteristics of the folding machine and according to needs.

9) Second cutting tool utilized in the process according to Claims 3, 4, 7, and 8 characterized in that it can be configured in order to treat the entire length of the first fold considered, and in this case the placement of the crossing of the second fold should correspond to a clean cut through both sides of said cross.

10) Second cutting tool utilized in the process according to Claims 3, 4, 7, 8, and 9 characterized in that it can be configured to treat a single side of the first intended fold, and in this case the clean cut (13) begins on only one side of the point precisely foreseen for the crossing of the second fold, the other side in front of it to then begin with a complete absence of cutting edge and teeth (14).

11) Second cutting tool utilized in the process according to Claims 3, 4, 7, 8, 9, and 10 characterized in that it can include /12 clearance (17) in the holes (22) intended for mounting it, in order to facilitate lateral position adjustment and the inversion of the operational side, by turning it around.

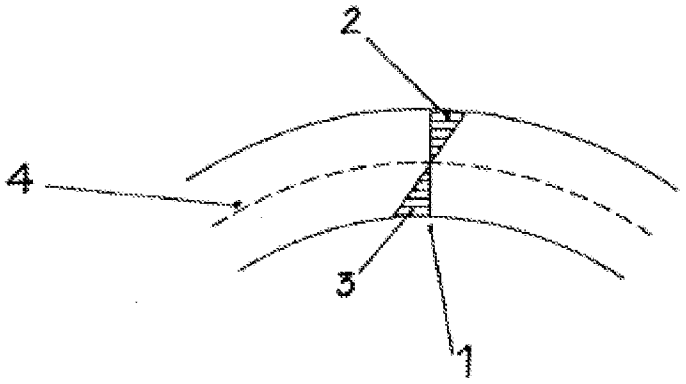

FIG. 1

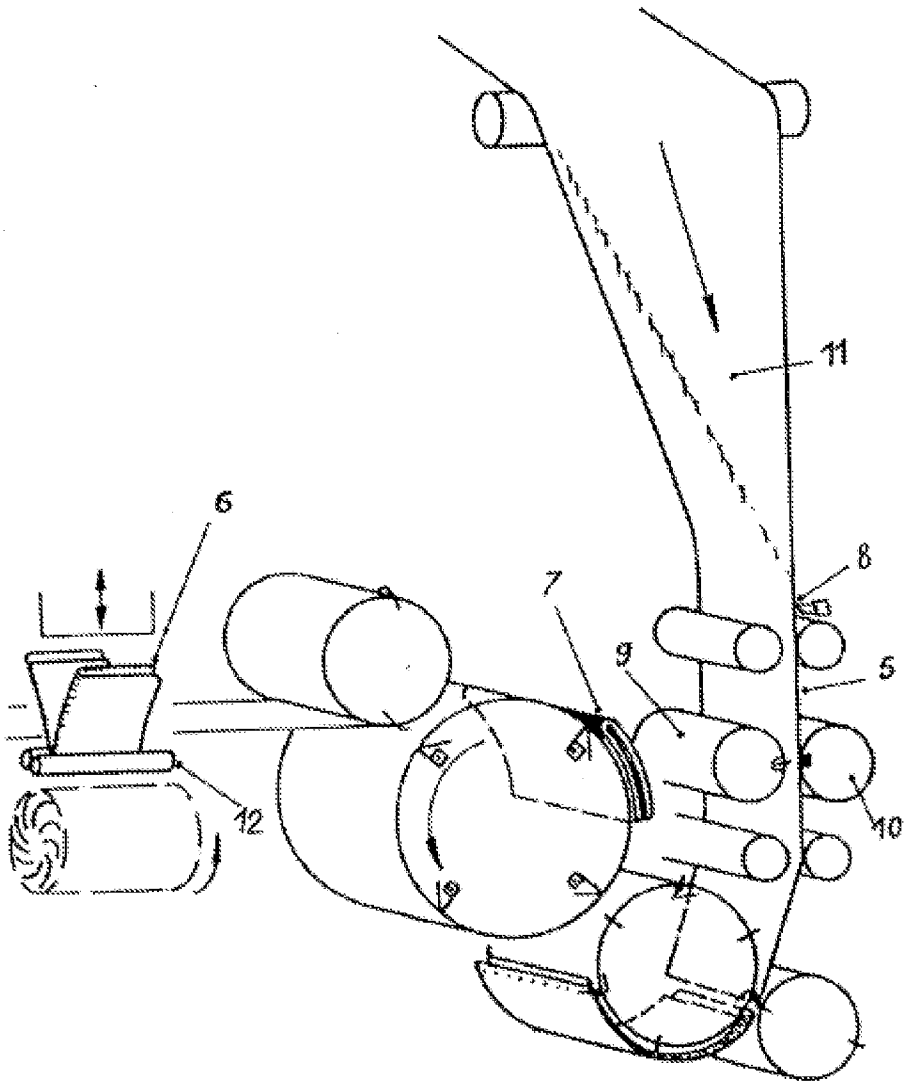

FIG. 2

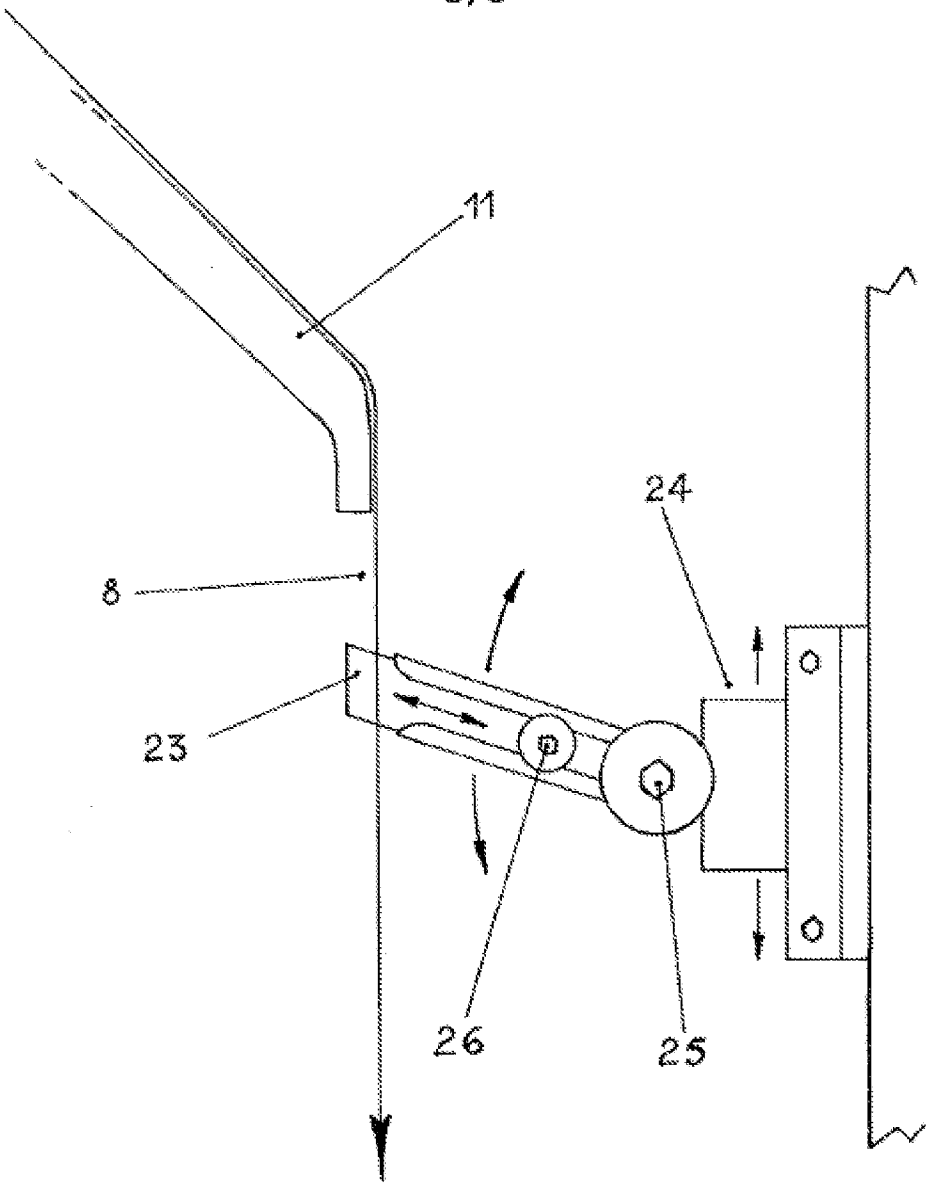

FIG. 3

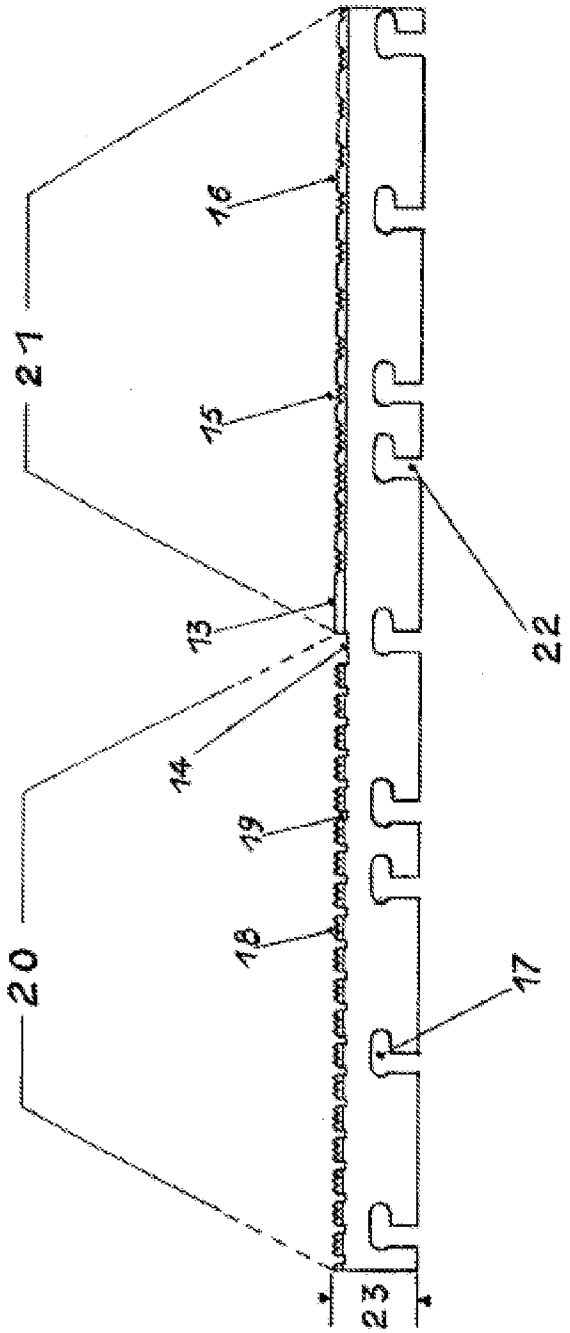

FIG. 4

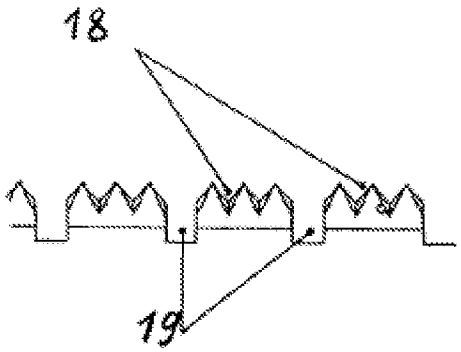

FIG. 5

FIG. 6